A Compression Artifacts Reduction Method in Compressed Image

Jagjeet Singh
Department of Computer Science & Engineering
DAVIET, Jalandhar

Harpreet Kaur
Department of Computer Science & Engineering
DAVIET, Jalandhar

ABSTRACT
The region of image compression since it is applicable to various fields of image processing. The key goal of compression is to cut back the space for storage and decrease the transmission cost and maintain the visual quality of image. This paper presents fundamental approach for analysis and evaluating the image compression techniques. This paper describes the many techniques which can be used for image compression and describes about artifacts which can be consequence of compression and their reduction techniques. This paper presents a new Canny edge based restoration method to remove artefacts from compressed image. Firstly standard JPEG compression is used to compress the first image. Compressed image contains various visible artefacts like blurring artifacts, blocking artifacts and ringing artifacts. Then to remove ringing artifacts proposed method i.e. image restoration as a post processing method is used. Experimental effects of proposed method by use of various performance parameters are good.

General Terms
Image Compression and reduction of compression artifacrs

Keywords
JPEG Image compression, artifacts, Edge preservation based Image restoration method..

1. INTRODUCTION
Digital image processing signifies towards usage of digital pictures by computerized resources. Awareness in digital image processing devices stalks from two chief application areas:

- Enrichment of photographs material for humanoid understanding.
- To course the image data for storing, broadcast, and description for machine surveillance.

Digital is self-possessed to have a certain amount of image essentials. Each constituent is the position and significance. These essentials as picture basics or pixels have been asked to.

Visualization plays a very chief role in humanoid understanding. Three types of hi-tech ways to course digital images:

- Low-level method
- Mid-level method
- High-level method

Low-level method and a practice for the organization of specific items applicable to moderate them to elementary actions such as subdivision, plus a report of those goods

A mid-level method branded by the datum that its inputs customarily are imageries.

Lastly, the higher level method image as a mass of aware objects, together with the edifice of logic.

1.1.Compression
Digital images and uncompressed program data storage and spread bandwidth necessitates important stowage bulk, because the show of images of huge expanses of data transferal issue is attentive (see Fig.2). Image compression is a composite dimensional space to a lower dimensional space is one of the plotting.

Fig.1 Process of Image compression

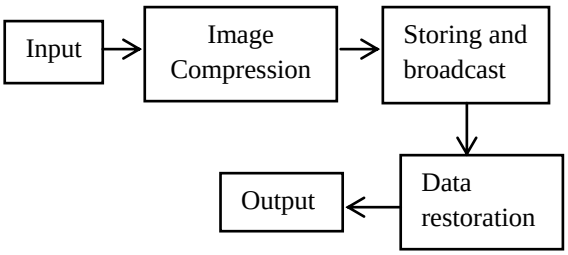


Fig.2 Image compression for storage and broadcast

Basically image compression is done for efficient storage and broadcasting of digital image.

1.2. JPEG Compression
JPEG compression is lossy compression, image compression mode. Joint Photographic Experts Group. A ordinary compression scheme for still images as it has been recommended. Block of 8x8 pixel JPEG discrete cosine transform coefficients change for stuffing material in the narrow uses.

Discrete processing of each image chunk is visually blocking effect. JPEG was designed to compress both grey scale as well as colored images.

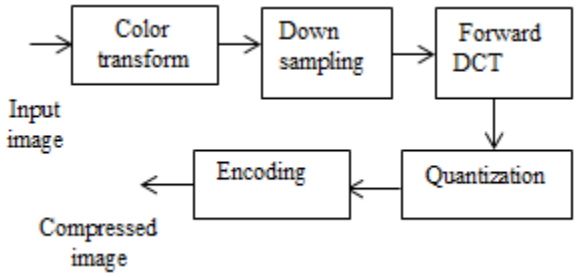


Fig.3. JPEG image compression

1.3.Limitations of compression

When we compress the image by use of compression techniques it encounters artifacts in resultant image.

Artifacts

When image compressed by use of various techniques of image compression then compressed image may encounter visual distortion i.e. Compression artefacts. Artefacts are of various types, like, Blocking artefacts, Ringing artefacts, Blurring artefacts, color artefacts.

1.3.1 Blocking Artifacts

One of the most encountered disadvantages of the JPEG compression [3] is when we compress the image at very low bit rates then the compression can leave discontinuities of intensities between blocks known as blocking artifacts. JPEG can also lead to other visual artifacts such as degraded textures, blurring and distortion of edges i.e. with decreasing the bit rates will increase the occurrence of these visual artifacts [3].

1.3.2 Blurring artifacts

Blurring in an image is cause of high spatial frequencies, which commonly occurs during filtering or compression. Blurring artifacts occurs all around the images.

(a) (b)

Fig.4 (a) Original image (b) Image with blurring artifacts

1.3.3 Ringing artifacts

Ringing artefacts is caused by heavy truncation on transform coefficients and can also come from improper image restoration operations. Mostly post-processing method is preferable to remove these artefacts.

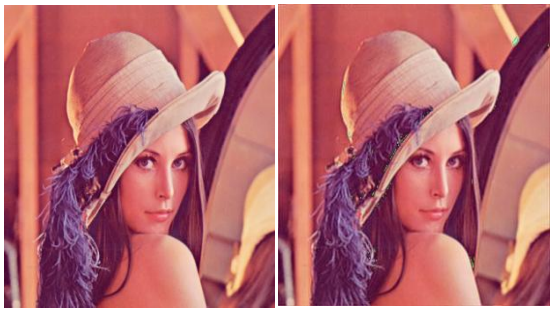
(a) (b)

Fig.5 (a) Original image (b) Image with ringing artefacts

1.3.4 Color artifacts

The main difference between the color artifacts and non-color artifacts is the color of image.

Color artifacts are the colored distortion i.e. changed color of image or unwanted color of image.



(a) (b)

Fig.6 (a) Original image (b) Image with color artefacts

2. PROPOSED WORK

2.1 Edge preservation based restoration method

Image compression has turn into very significant instrument in digital image processing. The chief goal of the compression is to decrease the quantity or undesirable data whereas holding the info in the picture. The aim behindhand is to save the quantity of memorial essential to save the imageries or to exploit linkage bandwidth in effective style. Transform-based compression [11] is widely used for image compression. But transform grounded approaches present blocking artifacts in the outcome picture. The compression ringing artifacts [10] around edges can be efficiently removed using edge restoration as a post- processing. Most of the existing techniques are for gray scale images only. Therefore, artifacts prompted through processing of the DCT constituents of the chrominance networks are not noticed. The use of the color artifacts removal techniques has also ignored in the existing research.

The main objective of our research is to use canny edge detector based restoration method as a post processing to remove the ringing artifacts from the compressed images.

Canny edge detector

- This is possibly the greatest broadly used edge detector in processor visualization.
- Canny has revealed that the first derivative of the Gaussian carefully approximates the operator that optimizes the product of signal-to-noise proportion and localization.

- Examination is grounded on "step-edges" degraded by "additive Gaussian noise".

Fig 7 Edge map of Lena by Canny Edge Detection

Image restoration
By this method, one expresses post-processing as an picture retrieval difficult.

1. In this method firstly we normalized the image and then calculate mean by using two variables. We have taken 8*8 mask then create histogram of image.

$$U = q_1(i-4{:}\,i+4, j-4{:}\,j+4);$$

$$\text{hist} = \text{imhist}\big((U), 10\big);$$

2. After creating histogram finite limit of image will be check, if image is infinite then it will be rejected here otherwise compute gradient of image. Gradient of image will be find on separations based that is x and y axis.

Gradient fundamentally calculate to show how image is changing.

2.2. Results and Discussions

Results of proposed method are of better quality than existing method. Here we have present the results of lena image for both existing method and for proposed method. Then we have given the performance metrics values in table1 for lena image that be input image. Here performance of existing method and proposed method i.e canny edge based restoration method is evaluated on the base of following parameters in Performance Evaluation section.

Performance Evaluation:

To compare the proposed method with [S.Alireza Golestaneh et al., 2014] on the basis on the following parameters:

2.3. Peak signal to noise ratio(PSNR)

It is used to evaluate the quality of the image. PSNR is the ratio between the maximum possible power of a signal and the power of degrading noise that affects the constancy of its representation.

$$\text{PSNR} = 10\log_{10}\frac{(2^b-1)^2}{\text{MSE}}\ dB$$

Where b = no of bits per pixel (bpp)

MSE = Mean square error

PSNR needs to be maximized for better results. Table1 has clearly shown the PSNR maximum in the case of proposed method. So the proposed method has better results than the available methods.

Table 1 is showing the comparative analysis of the peak signal to noise ratio (PSNR).

Test Images	Existing method [S.Alireza Golestaneh et al., 2014]	Proposed method
1.	29.3929	30.5030
2.	25.4528	27.9001
3.	31.5594	32.6183
4.	25.1133	27.2824
5.	28.1790	28.8948
6.	27.0147	27.8631
7.	30.0930	31.0315
8.	29.9031	30.1224

3. MEAN SQUARE ERROR (MSE)

It is cumulative square error between compressed image and referenced image.

$$\text{MSE}=\frac{1}{MN}\sum_{m=1}^{M}\sum_{n=1}^{N}[I(m,n)-F(m,n)]^2$$

Where I (m,n) is the pixel value of referenced image

F(m,n) is pixel value of compressed image

Table 2 depicts the analysis of the mean square error. As mean square error needs to be reduced. So the proposed method shows the better results than the available method.

Test Images	Existing method [S.Alireza Golestaneh et al., 2014]	Proposed method
1.	74.7815	57.9138
2.	185.2694	105.4565
3.	45.4087	35.5836
4.	200.3338	121.5732
5.	98.8964	83.8696
6.	129.3049	106.3572
7.	63.6480	51.2783
8.	66.4928	63.2175

4. BIT ERROR RATE

The bit error rate [31] (BER) is the ratio of bits that have faults comparative to the entire amount of bits received in a broadcast. The bit error rate (BER) is the number of bit faults divided by the aggregate number of transported bits through a studied time intermission.

Table 3 shows the comparison among Existing and proposed method based on bit error rate. As the bit error rate is fewer in almost each taken Lena image; therefore the proposed method has shown significant results over the available technique.

Test Images	Existing method [S.Alireza Golestaneh et al., 2014]	Proposed method
1.	0.0340	0.0328
2.	0.0393	0.0358
3.	0.0317	0.0307
4.	0.0398	0.0367
5.	0.0355	0.0346
6.	0.0370	0.0359
7.	0.0332	0.0322
8.	0.0334	0.0332

5. ROOT MEAN SQUARE ERROR

The root mean square error is a commonly used to find of the differences among the values projected by a technique and the values truly perceived The great value of root mean square means that image is of poor quality.

Table 4 shows the comparison among Existing and proposed method based on Mean Square error. As the Mean Square error is less in almost every taken image; therefore the proposed strategy has shown significant results over the available technique.

Test Images	Existing method [S.Alireza Golestaneh et al., 2014]	Proposed method
1.	8.6478	7.6101
2.	13.6114	10.2692
3.	6.7386	5.9652
4.	14.1539	11.0260
5.	9.9447	9.1580
6.	11.3712	10.3130
7.	7.9780	7.1609
8.	8.1543	7.9509

6. MEAN STRUCTURAL SIMILARITY INDEX

This index is used to compare the similarity of two imageries. The structural similarity index is an Emmy Award-winning method for predicting the perceived quality of compressed image with respect to original image.

Table 5 shows the comparison among Existing and proposed method based on Mean Structural Similarity Index. As the Mean Structural Similarity Index is more in almost every taken image; therefore the proposed strategy has shown significant results over the available technique.

Test Images	Existing method [S.Alireza Golestaneh et al., 2014]	Proposed method
1.	0.8320	0.8577
2.	0.8087	0.8724
3.	0.8332	0.8566
4.	0.7933	0.8595
5.	0.7817	0.8065
6.	0.8027	0.8361
7.	0.8184	0.8445
8.	0.8755	0.8838

7. GUI OF PROPOSED METHOD

GUI formed by us for the better visualization of the results. Moreover with the help of the GUI, it becomes easy for the user to use the system. It is hard to understand and use the command line interface, therefore we have created a simple GUI. GUI comprises of the Browse button, Existing Technique button, Proposed Technique button, Close button, and five text-boxes to show the values of the performance metrics.

A. Working of the GUI

Below figures signify the general working of the GUI for artifacts removal. The FIG1 shows the Graphical User Interface of the artifacts exclusion after compression of image. It shows various text-boxes and buttons designated to perform various operations on the Lena images.

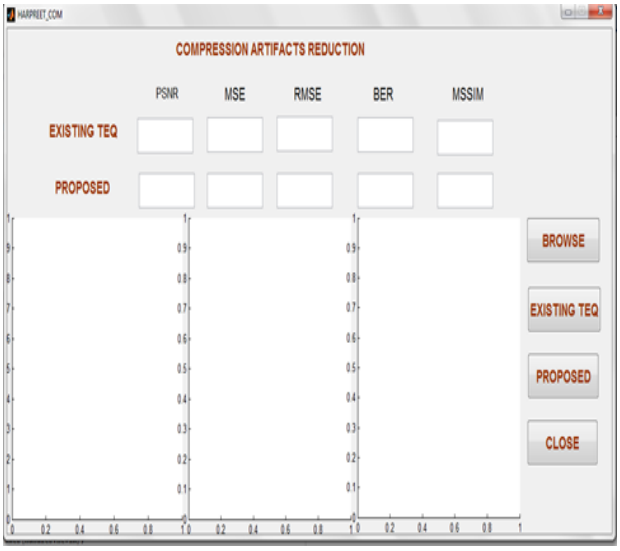


Fig. 8 GUI Interface

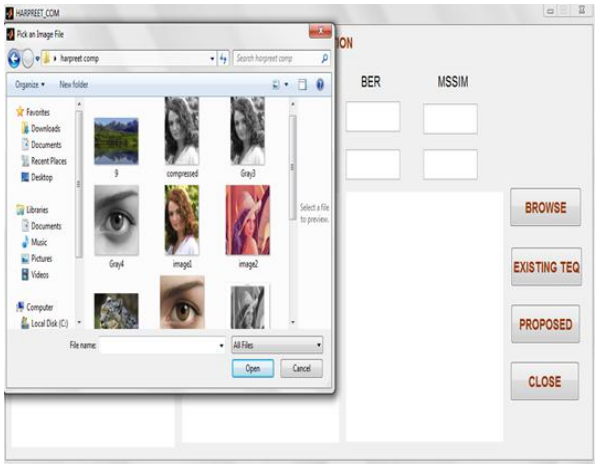


Fig. 9 GUI on Browsing button

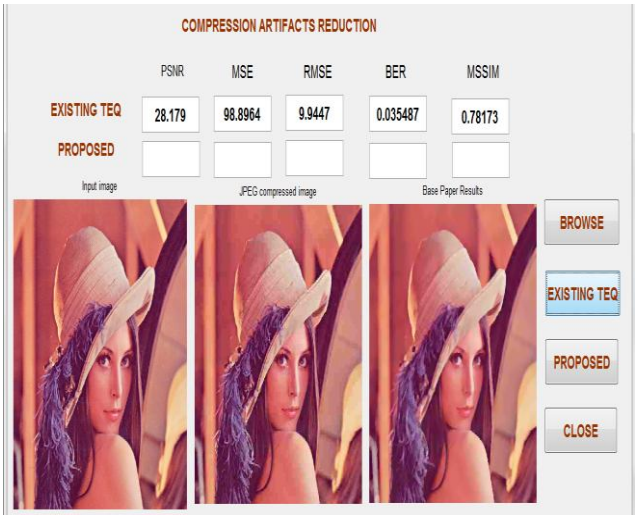


Fig. 10 GUI for edge regeneration method

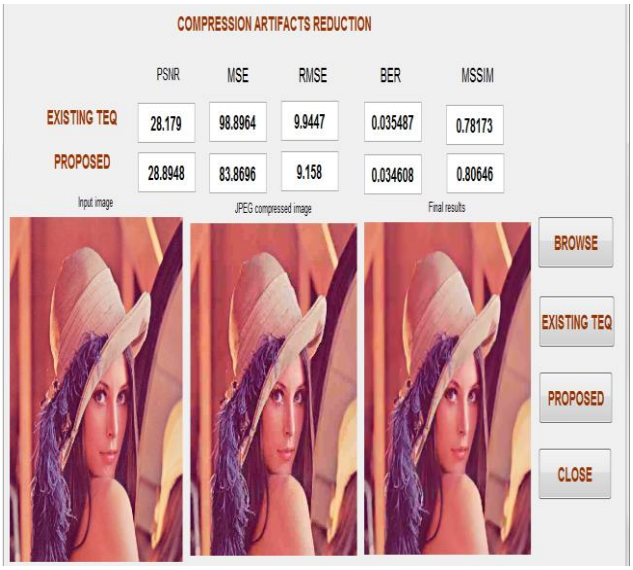


Fig. 11 GUI for proposed method

8. CONCLUSION

This paper presents a new method for artifacts removal from compressed image. Artifacts round the image degrade the visual quality of image. Restoration method as a post processing based on canny edge detections used to attain the good visual quality outcomes of the image. Compression of image encounters several types of artefacts in resultant image. This paper successfully improves the visual outcomes of the compressed image. This achieves better results than available method.

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